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I Z A
World of Labor
Evidence-based policy making

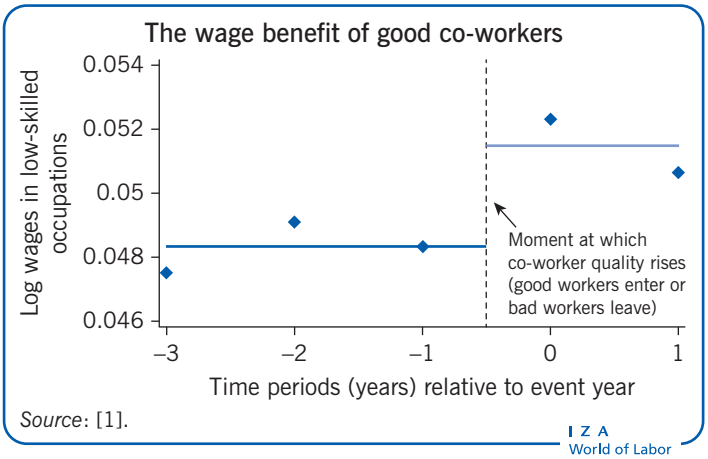
Do social interactions in the workplace lead to productivity spillover among co-workers?

Peer pressure can affect productivity and explain why workers' wages and productivity depend on their co-workers' productivity

Keywords: peer effects, productivity, wages, peer pressure, social pressure, knowledge spillover

ELEVATOR PITCH

Should one expect a worker's productivity, and thus wage, to depend on the productivity of his/her co-workers in the same workplace, even if the workers carry out completely independent tasks and do not engage in team work? This may well be the case because social interaction among co-workers can lead to productivity spillover through knowledge spillover or peer pressure. The available empirical evidence suggests that, due to such peer effects, co-worker productivity positively affects a worker's own productivity and wage, particularly in lower-skilled occupations.



KEY FINDINGS

Pros

- Peer effects in co-worker productivity have been documented for low-skilled occupations, such as supermarket cashiers, soft-fruit pickers, salespeople, and call center workers.
- Evidence suggests social interaction can lead to knowledge spillover from newly trained to untrained workers
- The likely channel of productivity spillover in low-skilled settings is peer pressure; this can also help overcome free-rider problems.
- Emerging representative studies complement evidence from lab and field experiments, producing an increasingly consistent and reliable body of evidence.

Cons

- Productivity spillover among co-workers in high-skilled occupations has been documented for school teachers, but not for academics, scientists, and inventors, unless they actively collaborate on a project.
- The current evidence does not point toward knowledge transfer as an important channel of productivity spillover in general workplace settings.
- Firms with excessively high peer pressure are likely to face extra costs in retaining workers.
- In many settings it is difficult to measure worker and co-worker productivity or to establish causation among the two, which limits researchers' ability to accurately determine productivity spillover.

AUTHOR'S MAIN MESSAGE

Evidence suggests that peer pressure affects productivity and is an important reason why workers' wages and productivity depend on their co-workers' productivity. Peer pressure can help mitigate free-rider problems in teams, but excessive peer pressure can also depress worker well-being and require firms to pay higher wages to retain workers. Peer effects due to knowledge spillover seem to be relevant in specific situations, such as when newly trained and untrained workers interact, in collaborative team settings, or between senior and junior workers. In such instances, firms should encourage social interaction.

MOTIVATION

Does a worker's productivity depend on the productivity of his/her co-workers in the same workplace? The answer is obviously yes in cases where production is organized in such a way that workers' productive inputs are complementary, as is the case with teamwork or with a conveyer belt type production line. However, a more subtle question is whether the social interaction among co-workers that necessarily occurs in the workplace leads to productivity spillover among co-workers, even in settings where workers carry out independent tasks that do not directly affect each other's output. Two important channels of such productivity spillover are peer pressure (or social pressure) and knowledge spillover (learning from co-workers). Peer pressure is rooted in the comparison of individual versus co-worker productivity and occurs if workers feel socially obliged (possibly reinforced by feelings of guilt or shame) to increase their own productivity if it falls behind that of their co-workers, or falls short of a social norm. Knowledge spillover captures the idea that by communicating and observing each other at work, workers learn from each other and build up skills they would otherwise not have. Peer pressure can help alleviate free-rider problems in teams, and knowledge spillover can raise the benefits from providing training to the workforce or from hiring knowledgeable workers. Evidence on the extent and nature of such peer effects thus has important implications for human resource management and the organization of work.

DISCUSSION OF PROS AND CONS

Productivity-enhancing peer effects have several important implications. First, they affect how work should be organized within firms. Positive peer effects due to peer pressure or knowledge spillover imply that the total productivity of the workforce is higher when employees work together within firms rather than from home. As such, it appears beneficial for firms to create spaces and occasions for social interaction to facilitate knowledge spillover, and to disseminate transparent information about individual worker productivity to facilitate social comparisons and peer pressure. Second, if social pressure is found to be relevant, this indicates that workers react to social incentives, which can help alleviate free-rider problems in teams. Third, when high-quality workers tend to sort into the same peer groups, positive peer effects may reinforce initial productivity differences between workers, thereby increasing wage inequality. Finally, through knowledge spillover, skills of knowledgeable workers may be transferred to a firm's workforce more widely, thus increasing the return that the firm gets from training workers, or from hiring knowledgeable workers.

Despite the economic relevance of peer effects in co-worker productivity, the literature in this area is still limited, partly due to the methodological challenges involved.

Challenges in studying peer effects in co-worker productivity

Estimating peer effects in co-worker productivity poses several challenges. First, it requires measures of worker productivity and the possibility to identify the relevant co-workers with whom a worker interacts in the workplace. This may be more easily available when analyzing data from specific settings, such as a single occupation in a specific firm. Occupations in which relatively standardized tasks lead directly to an observable output (e.g. supermarket cashiers and fruit pickers), and settings in which workers interact in

clearly defined shifts or teams (e.g. call centers and conveyer belt production lines) are especially suited to studying productivity spillover among co-workers. Such settings pertain in particular to low-skilled tasks or occupations, from which most of the current evidence on peer effects is derived.

Second, it is methodologically challenging to establish cause and effect in the behavior of peers. A positive observed correlation between the performances of two workers does not necessarily mean that both workers influence each other's productivity positively. It is also consistent with, say, worker A influencing worker B strongly positively, but worker B not influencing worker A at all (or worker B even influencing worker A slightly negatively). This impossibility of inferring the direction and sign of the causal influence between peers from simple correlations of their behavior is known as the "reflection problem." Some studies find ways to deal with this problem, others avoid it by analyzing the effect of a co-worker's predetermined characteristic (e.g. his/her education) on a given worker's performance, because then causality is likely to run in one direction only (namely from worker A's education to worker B's performance, but not from worker B's performance to worker A's education).

Third, even when estimating the effect of a predetermined co-worker characteristic (such as education) on individual worker performance, unobserved "confounding factors" pose a problem. Sometimes, the researcher does not observe important details of the work environment, such as the organization of work, hierarchies within the firm, or the compensation scheme. If such unobserved characteristics affect both workers' wages and the quality of their peers, then this might erroneously be taken for a peer effect. For example, a firm may restructure its work processes, introducing a new performance evaluation system that increases a given worker's performance; at the same time, the firm may hire better-educated co-workers, thereby increasing his/her co-workers' educational characteristics. Such "confounding factors" might lead to wrong conclusions about peer effects, but the analysis can adjust for such factors when they are observed or when they can be controlled by the researcher. Therefore, compelling existing evidence on peer effects in co-worker productivity is often based on either laboratory experiments (in which the environment can be controlled) or on real-world data from single firms or occupations (in which detailed information on the environment is observed).

While studies based on specific settings provide compelling and clean evidence for the existence (or absence) of peer effects in those settings, an interesting question is to what extent such findings apply to the labor market in general. Studies based on data that are representative of more general workplace settings are currently emerging. These studies face the challenge of finding comparable productivity measures across occupations and of controlling for confounding factors. When examining the existing evidence, it is useful to distinguish between settings with low- and high-skilled tasks, where the process of productivity spillover may be quite different. In settings with low-skilled tasks, the more likely channel is social pressure (and the empirical literature has in general found positive productivity spillover effects), while in settings with high-skilled tasks the more likely channel is knowledge spillover (and less evidence of productivity spillover has been found).

Productivity spillover in low-skilled tasks

Partly for the reasons discussed above, much of the current evidence on peer effects is derived from settings characterized by low-skilled tasks or occupations. A well-known

study analyzes the productivity of supermarket cashiers in a large supermarket chain and finds that cashiers tend to work faster (scan items faster at the till) when they are assigned to a shift with faster co-workers, especially if they can be observed by the faster co-workers [2]. This latter fact suggests that the peer effect in co-worker productivity is likely due to social pressure. Another study looks at soft-fruit pickers, taking the friendship structure between the workers into account, and finds that workers are more productive when working on the same field with a more able friend, but less productive if working only with less able friends [3]. This finding points toward a social desire among friends to adjust their productivity when working alongside one another. Further research based on firm data from a multinational telephone company shows that the general pattern of peer effects within co-worker networks is consistent with conformist behavior; that is, driven by social norms or peer pressure, co-workers tend to "imitate" the productivity of their co-workers [4].

Other specific settings for which productivity spillover among co-workers has been identified include data-entry workers in an Indian company and cosmetics salespeople in a Chinese department store. In most of these settings, social-behavioral effects, such as peer pressure, are the most likely channels. An exception is the finding that a training program among call center workers increased not only the productivity of the participants themselves, but also the productivity of their untreated teammates, suggesting that this effect may at least be partly driven by knowledge spillover [4], [5]. Thus, while peer pressure seems to be the more common source of productivity spillover in low-skilled occupations, knowledge spillover is likely to be relevant in specific situations, for example in the interaction between newly trained and untrained workers.

Besides such field studies, there exist a number of experimental lab studies based on simple tasks. Some of them show that the mere presence of another individual carrying out the same task can increase productivity (most likely due to social pressure). While lab studies in general confirm the existence of positive productivity spillover, one study found that very low and very high levels of peer pressure *decreased* productivity, serving as a reminder that excessive peer pressure can be detrimental for worker productivity.

Productivity spillover in high-skilled tasks

Considerably fewer studies have analyzed high-skilled occupations, where knowledge spillover is more often the suspected channel of peer effects in productivity, and the picture that emerges is more mixed. While there is evidence for learning from co-workers among teachers in the same schools [6], knowledge spillover has not been documented among scientists in the same university departments [7]. However, the quality of academic staff in university departments affects doctoral students positively [8]. Similarly, very high quality co-authors and collaborators influence individual research output in medical sciences and mathematics positively [9], [10]. Conversely, at a wider geographical level, the large influx of Soviet mathematicians to the US in the 1990s strongly *reduced* the output of American mathematicians working in similar fields as the Soviet mathematicians [10], and there seems to have been no positive knowledge spillover of German Jewish scientists who emigrated to the US in the 1930s on individual US inventors working in similar fields [11].

The following important distinction may help explain the divergence in empirical results on knowledge spillover [10]. Among individuals who are collaborators (such as co-

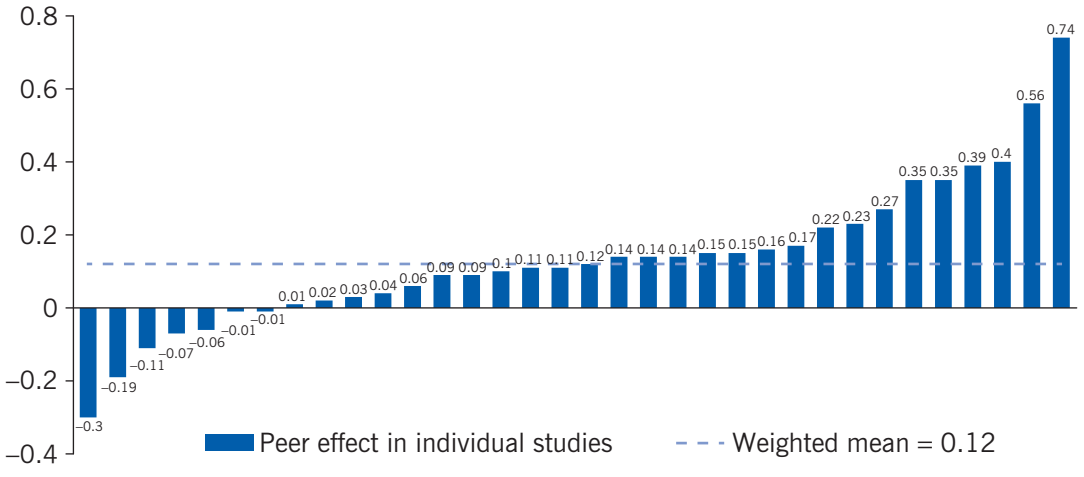
authors) or who are in a superior-subordinate relationship (such as PhD advisors and PhD students), a positive effect of peer quality on a worker's output can be expected simply because in a collaborative team, the productivity of a worker directly depends (positively) on the productivity of his co-workers. On the other hand, among peers who do not actively collaborate but who share the same geographical space (same university department) or idea space (same academic field), there is no reason to expect that their productivities directly depend positively on one another. On the contrary, there may even be a negative effect due to competition (i.e. the more successful are one's peers who work in the same field, the harder it is to get one's own research published). In line with this distinction between peers who are actively collaborating and those who are not, it has been found that the premature death of an inventor reduces the patenting and earnings of the co-inventors in their team, but not of other inventors in the same firm [12].

The bigger picture

The literature provides compelling and clean evidence for the existence (or absence) of peer effects in specific settings and conveys the notion that peer effects in co-worker productivity exist in a range of low-skilled occupations, but that they are less frequent in high-skilled occupations, where they seem primarily to be related to collaborators (team members who work on the same task, including supervisor-subordinate pairs). An interesting question thus becomes: to what extent do these findings based on specific firms or occupations, or on experimental evidence, apply to the labor market in general?

A first step in answering this question is to systematically analyze the existing studies; this has recently been done in a meta-analysis of 34 individual studies, from which an estimate of a peer effect in co-worker productivity can be derived [13]. The results are organized in Figure 1. The average coefficient 0.12 implies that the effect of a, for example, 10% change in co-worker productivity on a worker's own productivity is about 1.2% on average across the included studies. Further interesting results emerge from this meta-analysis. First, the

Figure 1. Workers' productivity response to a 1% increase in the productivity of co-workers



Note: The results are drawn from a recent meta-analysis. Workers' productivity response is measured independently in each of the 34 studies (x-axis) and a derived average is shown.

Source: Data from Herbst, D., and A. Mas. "Peer effects on worker output in the laboratory generalize to the field." *Science* 350:6260 (2015): 545–549 [13]; Figure 1.

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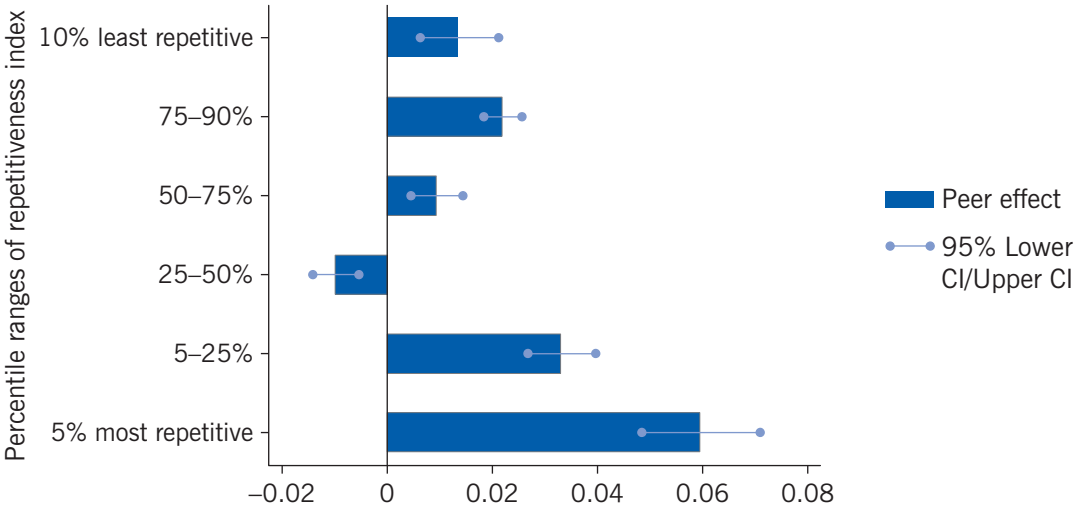
difference in the peer effect estimated in field studies and lab experiments is small and not statistically significant, which prompts the authors to conclude that the results on peer effects in co-worker productivity from lab experiments do generalize to the field. Second, in line with the more mixed evidence for high-skilled occupations, the peer effect is smaller in samples that include more complex tasks. A further noteworthy result of the meta-analysis is that peer effects in co-worker productivity are larger under group piece-rate or fixed-wage conditions, that is, in the absence of individual piece rate pay. With team-based production, this is exactly the situation in which workers have incentives to free-ride on their co-workers (i.e. workers reduce their own effort because co-workers pick up the slack); peer pressure and workers' desire to conform to social norms can help prevent workers from taking too much advantage of their co-workers and are therefore thought to help overcome free-rider problems, so it makes sense that peer effects are found to be higher in this situation.

A second step in assessing the generalizability of findings for specific settings is to analyze large-scale data for a representative set of workers, firms, and sectors, as recently provided by a study analyzing matched employer-employee data for a large local labor market in Germany [1]. The study addresses the challenge of finding a comparable output measure across a large range of occupations by focusing on peer effects in wages instead of physical productivity. As discussed above, unobserved confounding factors pose a challenge. As an example, bad management decisions may lead to a loss of market share and revenue, which may force a firm to raise wages at a slower rate than other firms, subsequently motivating the best workers to leave. This would induce a correlation between peer quality and wages for reasons unrelated to peer effects. The study controls for such unobserved factors by implementing a research design that ultimately identifies the peer effect by estimating to what extent an individual's wage changes (relative to wage changes in other occupations in the same firm) in response to a given change in peer quality within their own occupation in the firm (relative to worker quality in other occupations in the same firm). By looking at changes over time for those who remain in the same peer group, unobserved factors at occupation-firm level are held constant, and by using variation relative to other occupations in the same firm, unobserved factors that affect the whole firm in a given year are netted out (such as the example of the bad management decision mentioned above).

Interestingly, after having thus controlled for a large set of confounding factors, the study finds almost no peer effects in wages for all occupations in the sample [1]. However, when distinguishing between occupations with a high and low incidence of repetitive and predefined tasks, the authors do find larger peer effects in occupations with more repetitive and predefined tasks, such as cashiers, agricultural workers, and other mostly low-skilled manual occupations. This is depicted in Figure 2, which shows that the peer effect in wages for the occupations with the most repetitive tasks is found to be about half as big in magnitude as the average peer effect found in the meta-analysis discussed above [13] and depicted in Figure 1. A smaller peer effect in wages is what one would expect if productivity differentials do not propagate fully into wages (i.e. if wages do not fully reflect actual differences between worker productivity).

The same study further addresses the question of what the channel of the peer effect in the sample of low-skilled occupations is, distinguishing between social pressure and knowledge spillover [1]. First, because these are occupations with relatively repetitive and predefined tasks, knowledge might be less important, and output might be reasonably

Figure 2. Estimate of peer effect in wages by repetitiveness of tasks within occupations



Note: The graph plots the percentage change in an individual wage resulting from a 1% increase in co-worker quality for different occupational groups according to the repetitiveness of the tasks carried out in these occupations. The effect of peer quality is highest in the occupations with the most repetitive tasks, lowest at intermediate levels of repetitiveness, and again somewhat higher at low levels of repetitiveness. The repetitiveness index is constructed from worker responses to a survey asking how frequently their job tasks repeat themselves and how frequently their job tasks are predefined in great detail. (CI = confidence interval).

Source: Cornelissen, T., C. Dustmann, and U. Schoenberg. "Peer effects in the workplace." *American Economic Review* (Forthcoming); Panel A, Figure 3 [1].

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well observable (a precondition for social pressure), so that the more likely channel is social pressure. However, learning on the job might still be relevant in these occupations, especially when a worker first enters the labor market, or when a worker starts a new job with a new employer. If the peer effects disappear after a few years of work experience or job tenure, then this would suggest knowledge spillover as a channel. However, the results show that even for older workers with more job tenure, part of the peer effect remains. Moreover, if knowledge spillover was the relevant channel, then the quality of past peers should have an effect because workers should retain knowledge learned from their peers, even after those peers leave the firm. But the results show that past peers do not matter. The authors thus conclude that social pressure rather than knowledge spillover is the main source of peer effects in the group of low-skilled occupations.

Perils of peer pressure

While peer pressure can increase worker effort, which in turn can help mitigate the well-known free-rider problem associated with teamwork, it does not necessarily make workers better off. Workers may dislike working under peer pressure, and if they are given the choice, they may well prefer working in an environment without it. Firms in which peer pressure is high may then face problems with worker retention, having to pay higher wages in order to retain workers. Theoretical and empirical results support this view [1]. Thus, while a moderate amount of peer pressure may be profit-enhancing from the point of view of the firm, excessive peer pressure may hurt both firm profits and worker well-being. Knowledge spillover, on the other hand, probably does not have any negative effect on worker well-being, though encouraging knowledge transfer among co-workers may still be

associated with some cost to the firm, such as providing the space and time needed for workers to meet and communicate.

LIMITATIONS AND GAPS

With some exceptions, the empirical literature has been more successful in identifying productivity spillover that is likely due to social pressure, rather than to knowledge spillover. Among high-skilled occupations, in which knowledge spillover might be expected, evidence of interdependencies in co-worker productivity comes mainly from collaborators within teams or supervisor-subordinate relationships. These interdependencies are likely to be at least partly due to underlying complementarities in the production process (i.e. collaborators directly influence each other's output via their individual contributions), and therefore do not necessarily present clean estimates of peer effects or knowledge spillover. Because learning and collaboration may often go hand in hand, it is hard to disentangle knowledge transfer from a complementarity in the production process, and knowledge spillover is therefore difficult to estimate empirically.

It should be noted that besides the effects of co-worker productivity on a worker's own productivity, which forms the center of the discussion in this article, there are also other types of peer effects in the workplace. For example, not only changes in actual co-worker productivity, but also mere changes in the *information* on co-worker productivity, and on co-workers' wages, can affect own productivity. Moreover, in addition to own productivity, worker absenteeism, worker turnover, and worker well-being can also be affected.

SUMMARY AND POLICY ADVICE

Social interaction among co-workers in the workplace is an important reason why workers' wages and productivity depend on their co-workers' productivity, even in settings where workers carry out independent tasks that do not by themselves affect the firm's production in a complementary way. Two important channels of such productivity spillover are peer pressure and knowledge spillover.

To date, there exists reliable evidence on the existence of productivity spillover among co-workers in a diverse range of low-skilled occupations. At the high-skilled end, productivity spillover has been documented, for example, for teachers in the same school, but not for academics and scientists working in the same departments, nor for inventors working in the same firm (unless they actively collaborate on a project). This pattern of stronger peer effects in lower-skilled occupations is also confirmed by more representative large-scale observational evidence.

Productivity-enhancing peer effects have important implications for the organization of work and, more generally, for our understanding of the labor market. If there are strong positive peer effects due to peer pressure or knowledge spillover, then the total productivity of the workforce is higher when workers are working together within the firm rather than from home; it would thereby be beneficial for the firm to create spaces and occasions for social interaction and communication (to facilitate knowledge spillover), and to disseminate information about own and co-worker productivity (to facilitate peer pressure). Empirical evidence suggests some degree of segregation across firms in terms of worker performance, that is, more productive and knowledgeable workers tend to sort with other productive and knowledgeable workers into the same firms, and the same is

true for less productive and knowledgeable workers. Such sorting implies that peer effects amplify pre-existing productivity differentials among workers, which may contribute to increased wage inequality.

Economic theory and empirical evidence suggest that if workers dislike working under pressure, then firms in which peer pressure is too high may encounter problems with worker retention, which may force them to pay higher wages in order to retain workers. Peer pressure may thus help in certain situations, but is not a panacea to solve incentive problems. Knowledge spillover has probably no adverse effect on worker well-being, but encouraging knowledge transfer among co-workers may still incur costs to the firm. Such provisions should be targeted to situations in which one can expect knowledge transfer to be important, such as when newly trained and untrained workers or junior and senior workers interact, or when employees work in collaborative teams. From the point of view of the individual worker, the possibility of knowledge spillover makes it desirable to work alongside other highly productive workers, in particular if the costs of acquiring helpful knowledge from co-workers are low.

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Competing interests

The IZA World of Labor project is committed to the *IZA Guiding Principles of Research Integrity*. The author declares to have observed these principles.

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